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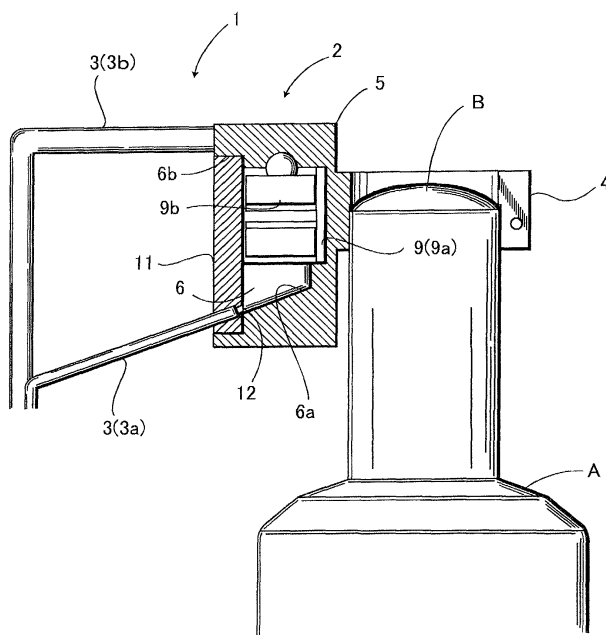
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(54) **Thermosiphon**

(57) A thermosiphon (1) is provided of low cost and simple construction and having a condenser (2) which can reliably discharge a condensed working fluid from an outlet pipe even if the apparatus is somewhat inclined. A thermosiphon (1) comprises a condenser (2) connected to a cold part (B) of a refrigeration apparatus (A), and a capillary (3a) and a large diameter pipe (3b) connected to the condenser (2) and which can pass a

working fluid thereinside. The condenser (2) comprises; an attachment part (4) attached to the cold part (B), and a condensing part (5) provided at an end of the attachment part (4) for condensing the working fluid. The condensing part (5) has a cavity portion (6) thereinside, an inside bottom part (6a) of the cavity portion (6) featuring a slope descending towards an outlet hole (12) which communicates with the capillary (3a) for the working fluid.

FIG. 3



EP 1 369 659 A1

Description

[0001] The present invention relates to a thermosiphon, and in particular to a condenser for condensing a working fluid in a thermosiphon.

[0002] A known thermosiphon intended to be used, for example, in a refrigeration apparatus, includes, according to a first configuration, a condenser which is constructed by coiling a part of a pipe with a working fluid filled therein into a coil shape, said condenser being covered over an outer periphery of the cold part of the refrigeration apparatus. Also known is a thermosiphon according to a second configuration, in which an inlet pipe and an outlet pipe for a working fluid are connected above and below a condenser constructed with a plurality of holes bored in parallel in a metal block so as to surround a cold part, a working fluid being filled into the condenser, the inlet pipe and the outlet pipe. In such a thermosiphon, the holes communicate with an inside bottom part of the condenser, the construction being such that the working fluid condensed in the holes accumulates at the inside bottom part of the condenser and flows out from an outlet portion to an outlet pipe connected to the bottom side of the condenser.

[0003] However, if an apparatus using a thermosiphon according to the first configuration is inclined, the condensed working fluid accumulates inside the condenser, so a drop in the heat transport efficiency may occur. Moreover, in an apparatus using a thermosiphon according to the second configuration is inclined, then depending on the incline direction, the position of the liquid portion can become higher than the inside bottom face of the condenser. If so, then as with the first configuration, the condensed working fluid accumulates inside the condenser so that a drop in heat transport efficiency may occur. Furthermore, the large number of holes to be bored in the metal block causes an increase in the manufacturing cost of the thermosiphon.

[0004] It is an object of the present invention to solve the above-mentioned problems by providing a thermosiphon of low cost and simple construction and having a condenser which can reliably discharge a condensed working fluid from an outlet pipe even if the apparatus is somewhat inclined.

[0005] According to a first aspect of the present invention, a thermosiphon comprising a condenser connected to a cold part of a refrigeration apparatus, and an inlet pipe and outlet pipe connected to the condenser and which can pass a working fluid therein, further comprises an attachment part attached to the cold part for conducting heat from the cold part, and a condensing part provided at an end of the attachment part for condensing the working fluid, the condensing part having a cavity portion therein, an inside bottom part of the cavity portion featuring a slope descending towards an outlet hole which communicates with an outlet pipe for the working fluid.

[0006] By having the above construction for the

present invention, when the working fluid in a vapor state which has flowed to the condensing part from the inlet pipe loses heat in the cavity portion inside the condensing part and is liquefied, it accumulates at the inside bottom part of the cavity portion and flows out from the outlet hole communicated with the outlet pipe. At this time, since the inside bottom part of the cavity portion features a slope descending towards the outlet hole which communicates with the outlet pipe of the working fluid, then even if the condenser is somewhat inclined, if this incline is less than the slope of the inside bottom part of the cavity portion which descends towards the outlet pipe, the working fluid does not accumulate in the condensing part, and flows along the inside bottom part of the cavity portion and flows out from the outlet hole to the outlet pipe. Hence there is no drop in heat transport efficiency.

[0007] In a thermosiphon according to a second aspect of the invention, the condensing part is constructed with a heat exchange member attached to the cavity portion. By constructing the present invention in the above manner, the condensing part can be easily constructed by attaching a separately formed heat exchange member inside the cavity portion

[0008] In a thermosiphon according to a third aspect of the invention, the heat exchange member is constructed from a plate-like base and a heat exchange part provided upright on the base, the construction being such that the cavity portion is sealed by the base. By constructing the present invention in the above manner, the heat exchange part of the heat exchange member can be inserted into the cavity portion formed in the condensing part, and the opening of the cavity portion can be sealed by the plate-like base of the heat exchange member. Therefore the sealing of the cavity portion and the attachment of the heat exchange member can be performed simultaneously. Hence assembly of the condensing part becomes even easier.

[0009] In a thermosiphon according to a fourth aspect of the invention, the inside bottom part of the cavity portion features a descending slope having a gradient of more than 10 degrees with respect to the horizontal direction when the condenser is connected to the cold part of the refrigeration apparatus. By virtue of the present invention, in a refrigeration apparatus incorporating a thermosiphon as described above, for which it is specified, for example by law, that it should not fall over if inclined at 10 degrees, since the inside bottom part is inclined at more than 10 degrees to the horizontal direction, the working fluid will not accumulate in the condensing part, and will flow down along the inside bottom part of the cavity portion and flow out from the outlet hole to the outlet pipe, even if the refrigeration apparatus is inclined within the specified range.

Fig.1 is a transverse section view showing a thermosiphon according to a first embodiment of the present invention.

Fig.2 is a vertical section view of the first embodiment.

Fig.3 is a vertical section view of the first embodiment seen from another direction.

Fig.4 is a transverse section view showing a thermosiphon according to a second embodiment of the present invention.

Fig.5 is a vertical section view of the second embodiment.

Fig.6 is a transverse section view showing a thermosiphon according to a third embodiment of the present invention.

Fig.7 is a vertical section view of the third embodiment.

Fig.8 is a vertical section view of the third embodiment seen from another direction.

[0010] Hereunder is a description of a first embodiment of the present invention based on Fig.1 through Fig.3. In these figures, A denotes a refrigeration apparatus. A thermosiphon 1 of this embodiment is attached to a cold part B of the refrigeration apparatus A. This thermosiphon 1 comprises a condenser 2 and a copper pipe 3 connected to the condenser 2. The condenser 2 comprises a band shape brass attachment part 4 and a condensing part 5 provided integral with the attachment part 4. Furthermore, the attachment part 4 is attached to the outer periphery of the cold part B so as to be tightly clamped in close contact thereto. Moreover, the condensing part 5 is formed in a box shape, with an interior forming a cavity portion 6. Through holes 7 and 8 communicating with the cavity portion 6 are formed in the upper side portions of the cavity portion 6. Furthermore, an inside bottom part 6a of the cavity portion 6 is formed with a slope so as to become lower towards the center and the outlet side, in a condition as shown in Fig.2 and Fig.3 with the condenser 2 attached to the cold part B. The gradient of the slope of the inside bottom part 6a is given a value of 15 degrees or more even at a position where the slope is most gentle with respect to the horizontal direction. Moreover, an aluminum alloy heat sink 9, being a heat exchange member, is secured to the cavity portion 6. The heat sink 9 comprises a plate-like base 9a and a plurality of fins 9b, being heat exchange parts, provided upright on the base 9a. The base 9a is secured to the cavity portion 6 on the attachment part 4 side with screws 10, which are tightened. By inserting a copper foil or the like (not shown in the figure) between the base 9a of the heat sink 9 and the cavity portion 6 and then tightening the screws 10, the copper foil is deformed so that the base 9a of the heat sink 9 and fine irregularities of the cavity portion 6 are filled. Hence and improvement in the heat conduction efficiency can be expected.

[0011] The cavity portion 6 is sealed by brazing a brass lid 11 into an opening 6b. Moreover, an outlet hole 12 is formed in a lower center of the lid 11 at a central lowermost edge position on the opening side of the cavity portion 6, and a capillary 3a of the pipe 3, being the

outlet pipe, is connected to the outlet hole 12. Since the inside bottom part 6a of the cavity portion 6 is formed in the above manner, inclined so as to become lower towards the central and opening side, the construction is such that the condensed working fluid flowing down to the inside bottom part 6a of the cavity portion 6 flows along the slope of the inside bottom part 6a and flows in to the capillary 3a from the outlet hole 12. Furthermore, a large pipe part 3b of the pipe 3, being an inlet pipe, is connected to the through hole 7 of the condensing part 5, the construction being such that the gasified working fluid is able to flow to inside the cavity portion 6 from the large pipe 3b via the through hole 7. Furthermore, the capillary 3a and the large pipe 3b are communicated via an article to be cooled (not shown in the figure).

[0012] A filling member 13 is connected to the through hole 8, the construction being such that the working fluid can be filled to inside the cavity portion 6 and the pipe 3 from the filling member 13 via the through hole 8. Then, after filling the working fluid to inside the cavity portion 6 and the pipe 3, the filling member 13 is sealed off.

[0013] The operation with this construction will now be described. When the refrigeration apparatus A is driven, heat is absorbed by the cold part B of the refrigeration apparatus A. Therefore, heat moves from the heat sink 9 and the condensing part 5 via the attachment part 4 to the cold part B, and as a result, the interior of the cavity portion 6 is cooled. Then, due to the interior of the cavity portion 6 being cooled, the working fluid existing inside the cavity portion 6 which is a vapor immediately after flowing in from the large pipe 3b, is condensed at the surface of the heat sink 9 (the fins 9b) and at the inside surface of the cavity portion 6, to become a liquid and then flows down to the inside bottom part 6a. At this time, since the inside bottom part 6a is inclined so as to descend towards the center of the cavity portion 6 and towards the outlet side, the condensed working fluid flows towards one point on the inside bottom part 6a. Then, since the outlet hole 12 is formed in the lower center of the lid 11 and corresponding to the center of the lowermost edge of the cavity portion 6 where the working fluid converges, the condensed working fluid reliably flows in to the capillary 3a of the pipe 3 from the outlet hole 12 without accumulating inside the cavity portion 6. In particular, in this embodiment, since even at the most gentle sloping position the gradient of the slope of the inside bottom part 6a is more than 10 degrees, then even if the entire body of the condenser 2, that is the refrigeration apparatus A itself, is inclined at 10 degrees, the working fluid reliably moves without accumulating. Electrical equipment safety laws normally specify that a unit such as a refrigerator incorporating the refrigeration apparatus A and the thermosiphon 1, should not fall over even if inclined at 10 degrees. Therefore, if the inside bottom part 6a is such that even at the most gentle slope position the gradient of

said slope is more than 10 degrees, the condensed working fluid will flow towards the outlet hole 12 in the inside bottom part 6a, provided the apparatus stays within the specified inclination range. Hence even if the apparatus such as the refrigerator incorporating the re-

[0014] The working fluid which has flowed into the capillary 3a of the pipe 3 in this manner after taking heat from an article to be cooled (not shown in the figure) of for example a cold room of a cold store and being gasified, returns to the cavity portion 6 from the large pipe 3b via the through hole 7, and again loses heat and is condensed. By repeating the above operation, the article to be cooled (not shown in the figure) is cooled.

[0015] The thermosiphon 1 of the present embodiment as described in detail above comprises; the condenser 2 connected to the cold part B of the refrigeration apparatus A, and the capillary 3a and large pipe 3b connected to the condenser 2 and through which the working fluid can flow thereinside. The condenser 2 comprises the attachment part 4 attached to the cold part B for conducting heat of the cold part B, and the condensing part 5 provided at the end portion of the attachment part 4 for condensing the working fluid. The condensing part 5 has the cavity portion 6 thereinside, and the inside bottom part 6a of the cavity portion 6 is formed so as to decline towards the outlet hole 12 which communicates with the capillary 3a. Hence when the vapor state working fluid flowing in from the large pipe 3b to the capillary 3a loses heat at the cavity portion 6 inside the condensing part 5 and is liquefied, this accumulates in the inside bottom part 6a of the cavity portion 6 and flows out from the outlet hole 12 which communicates with the capillary 3a. At this time, since the inside bottom part 6a of the cavity portion 6 is formed so as to decline towards the outlet hole 12 which communicates with the capillary 3a, then even if the condenser 2 is somewhat inclined, if this incline is less than the gradient of the slope of the inside bottom part 6a of the cavity portion 6 declining towards the outlet hole 12, a downward incline with respect to the horizontal direction is maintained. Hence the working fluid does not accumulate in the condensing part 5. The working fluid flows along the inside bottom part 6a of the cavity portion 6 and flows out from the outlet hole 12 to the capillary 3a, thus giving an improvement in heat transport efficiency. In particular, in the present embodiment, the inside bottom part 6a of the cavity portion 6 features a slope having a gradient of more than 10 degrees with respect to the horizontal direction when the condenser 2 is connected to the cold part B of the refrigeration apparatus A. Therefore, since it is specified by law that an apparatus incorporating the refrigeration apparatus A such as a refrigerator should not fall over even if inclined at 10 degrees, the working fluid will not accumulate in the condensing part 5, and will flow down along the inside bottom part 6a of the cavity portion 6

and flow out from the outlet hole 12 to the capillary 3a, even if the refrigeration apparatus is inclined within the specified range. Furthermore, the condensing part 5 is constructed in such a way that the heat sink 9 is attached to the cavity portion 6. By attaching the separately formed heat sink 9 to inside the cavity portion 6, the condensing part 5 can be easily formed, and hence the thermosiphon 1 can be easily manufactured.

[0016] Next is a description of a second embodiment of the present invention with reference to Fig.4 and Fig. 5. The thermosiphon of the second embodiment has basically the same construction as that of the first embodiment, and hence parts common to the first embodiment are denoted by common reference symbols and detailed description thereof is omitted. In this embodiment, an aluminum alloy heat sink 21, being a heat exchange member, is secured to the opening 6b of the cavity portion 6 of the condenser 2. The heat sink 21 comprises a plate-like base 21a and a plurality of fins 21b, being heat exchange parts, provided upright on the base 21a. By securing the outer periphery of the base 21a to the opening 6b of the cavity portion 6, a closed lid results. Furthermore, in this condition, the fins 21b of the heat sink 21 are positioned in the inner portion of the cavity portion 6. Moreover, an outlet hole 22 is formed in a lower center of the base 21a of the heat sink 21. The capillary 3a of the pipe 3, being the outlet pipe, is connected to the outlet hole 22, and as with the above described first embodiment, the construction is such that the condensed working fluid flowing down to the inside bottom part 6a of the cavity portion 6 flows along the inside bottom part 6a and flows in to the capillary 3a from the outlet hole 22.

[0017] The operation for the above construction will now be described. The operation itself of the present embodiment is basically the same as for the above described first embodiment. Accordingly, comparing the first embodiment and the present embodiment, in the first embodiment, the heat sink 9 which can be thought to have the greatest endothermic amount, is attached to the attachment part 4 side of the cavity portion 6. Therefore the heat absorbed by the heat sink 9 smoothly reaches to the cold part B via the attachment part 4. On the other hand, with the present embodiment, the heat absorbed by the heat sink 21 reaches to the cold part B from the attachment part 4 via the opening 6b and the condensing part 5. Therefore the absorption efficiency itself is not as good as for the first embodiment. However, in the first embodiment the interior of the cavity portion 6 must be closed off by the lid 11 after attaching the heat sink 9 thereto, whereas with the present embodiment, the base 21a of the heat sink 21 is also used as a lid. Hence attachment of the lid and attachment of the heat sink 21 can be simultaneously carried out in one step. Therefore assembly of the thermosiphon 1 is facilitated, enabling low cost manufacture.

[0018] Regarding the thermosiphon 1 of the present embodiment as detailedly described above, the heat

sink 21 comprises the plate-like base 21a and the fins 21b provided upright on the base 21a, the construction being such that the cavity portion 6 is sealed by the base 21a. Hence the fins 21b of the heat sink 21 can be inserted into the cavity portion 6 formed in the condensing part 5, and also the opening 6b of the cavity portion 6 can be sealed by the plate-like base 21a of the heat sink 21. Therefore the sealing of the cavity portion 6 and the attachment of the heat sink 21 can be performed simultaneously. Hence assembly of the condensing part 5 becomes even easier.

[0019] Moreover, a third embodiment of the present invention will now be described with reference to Fig.6 through Fig.8. The thermosiphon of the third embodiment has basically the same construction as that of the above-mentioned first embodiment, and hence parts common to the first embodiment are denoted by common reference symbols and detailed description thereof is omitted. In the thermosiphon 1 of the third embodiment, the condensing part 5 is formed in a box shape which is thinner than for the above mentioned first and second embodiments, and a first cavity portion 31 of cylindrical shape is formed thereinside. On a lower side of the first cavity portion 31, a heat exchange part 34 is formed by forming a plurality of through holes 33, being cold parts, vertically in a base 32. The lower side of the heat exchange part 34 constitutes an open cavity 35. This open cavity 35 is sealed by soldering a brass lid 36 thereto. Furthermore, a second cavity portion 37 is formed at the lower side of the heat exchange part 34 by the lid 36. The first cavity portion 31 and the second cavity portion 37 communicate via through holes 33. Moreover, an inside bottom part 37a of the second cavity portion 37, in a condition as shown in FIG. 7 with the condenser 2 attached to the cold part B, features a slope so as to become lower towards the center of the condenser 2, and at the central lowermost edge is formed an outlet hole 38 which is inclined downwards towards the through hole 7 side, and a capillary 3a of the pipe 3, being the outlet pipe, is connected to the outlet hole 38.

[0020] The operation of the present embodiment is basically the same as for the above-mentioned first embodiment in that the through holes 33 formed in the heat exchange part 34 perform the same function as the fins 9b in the above-mentioned first embodiment. In this manner, the heat exchange part 34 may be constructed by the plurality of through holes 33, and is not limited to the heat sink 9 provided with the fins 9b. Furthermore, provided that the inside bottom part 37a through which the working fluid flows is formed so as to descend towards the outlet hole 38, there is no particular limit to the inclination direction.

[0021] The above-mentioned respective embodiments of the present invention have been described with reference to the appended drawings, however the present invention is not limited to said above-mentioned respective embodiments, and various modifications are possible within a scope of the gist of the present inven-

tion. For example, in the above-mentioned respective embodiments, the construction is such that the inside bottom part of the cavity portion falls towards the center of the opening. However the construction may be such that said bottom part falls towards a position other than said center, such as an edge portion on either the left or right of the opening portion. Furthermore, the inside bottom part of the cavity portion is formed in a curved surface shape slope, however this may be formed in a flat surface shape. Moreover, in the above-mentioned respective embodiments, the outlet hole is formed in the lid, however this may be provided in the lower side of the condensing part. Furthermore, the invention has been described using the heat sink with fins provided upright on the base, as the heat exchange member. However, a heat exchange member other than this may be used.

[0022] A thermosiphon according to a first aspect of the present invention comprises a condenser connected to a cold part of a refrigeration apparatus, and an inlet pipe and outlet pipe connected to the condenser and which can pass a working fluid thereinside, an attachment part attached to the cold part for conducting heat from the cold part, and a condensing part provided at an end of the attachment part for condensing the working fluid, the condensing part having a cavity portion thereinside, an inside bottom part of the cavity portion featuring a slope descending towards an outlet hole communicating with an outlet pipe for working fluid. The working fluid in a vapor state which has flowed to the condensing part from the pipe loses heat in the cavity portion inside the condensing part and is liquefied, and accumulates at the inside bottom part of the cavity portion and flows out from the outlet hole communicated with the outlet pipe. At this time, even if the condenser is somewhat inclined, if this incline is less than the slope of the inside bottom part of the cavity portion which descends towards the outlet pipe, the working fluid does not accumulate in the condensing part, and flows along the inside bottom part of the cavity portion and flows out from the outlet hole to the pipe. Therefore, irrespective of the attitude under use conditions, the working fluid is well circulated inside the pipe so that this can operate reliably.

[0023] Furthermore, in a thermosiphon according to a second aspect of the invention, the condensing part is constructed with a heat exchange member attached to the cavity portion. Since the condensing part can be easily constructed by attaching a separately formed heat exchange member inside the cavity portion, it gives a thermosiphon where the condenser part is simpler, enabling a lower cost construction.

[0024] In a thermosiphon according to a third aspect of the invention, the heat exchange member is constructed from a plate-like base and a heat exchange part provided upright on the base, the construction being such that the cavity portion is sealed by the base. By inserting the heat exchange part of the heat exchange

member into the cavity portion formed in the condensing part, and also sealing the opening of the cavity portion by the plate-like base of the heat exchange member, one obtains a thermosiphon where the condenser can be easily constructed with a minimum number of parts. 5

[0025] Furthermore, according to a fourth aspect of the invention, the inside bottom part of the cavity portion features a descending slope having a gradient of more than 10 degrees with respect to the horizontal direction when the condenser is connected to the cold part of the refrigeration apparatus. In a refrigeration apparatus incorporating a thermosiphon as described above, for which it is specified by law that it should not fall over even if inclined at 10 degrees, the working fluid will not accumulate in the condensing part, and will flow down along the inside bottom part of the cavity portion and flow out from the outlet hole to the outlet pipe, even if the refrigeration apparatus is inclined within the specified range. 10 15 20

Claims

1. A thermosiphon comprising a condenser connected to a cold part of a refrigeration apparatus, and an inlet pipe and outlet pipe connected to said condenser and which can pass a working fluid therein-side, said condenser comprising; 25
 - . an attachment part attached to said cold part for conducting cold from said cold part, and 30
 - . a condensing part provided at an end of said attachment part for condensing said working fluid, 35

wherein said condensing part has a cavity portion therein-side, an inside bottom part of said cavity portion featuring a slope descending towards an outlet hole which communicates with an outlet pipe for working fluid. 40
2. A thermosiphon according to claim 1, wherein said condensing part is constructed with a heat exchange member attached to said cavity portion. 45
3. A thermosiphon according to claim 2, wherein said heat exchange member is constructed from a plate-like base and a heat exchange part provided upright on said base, the construction being such that said cavity portion is sealed by said base. 50
4. A thermosiphon according to any one of claim 1 through claim 3, wherein the inside bottom part of said cavity portion features a descending slope having a gradient of more than 10 degrees with respect to the horizontal direction when said condenser is connected to the cold part of the refrigeration apparatus. 55

FIG. 1

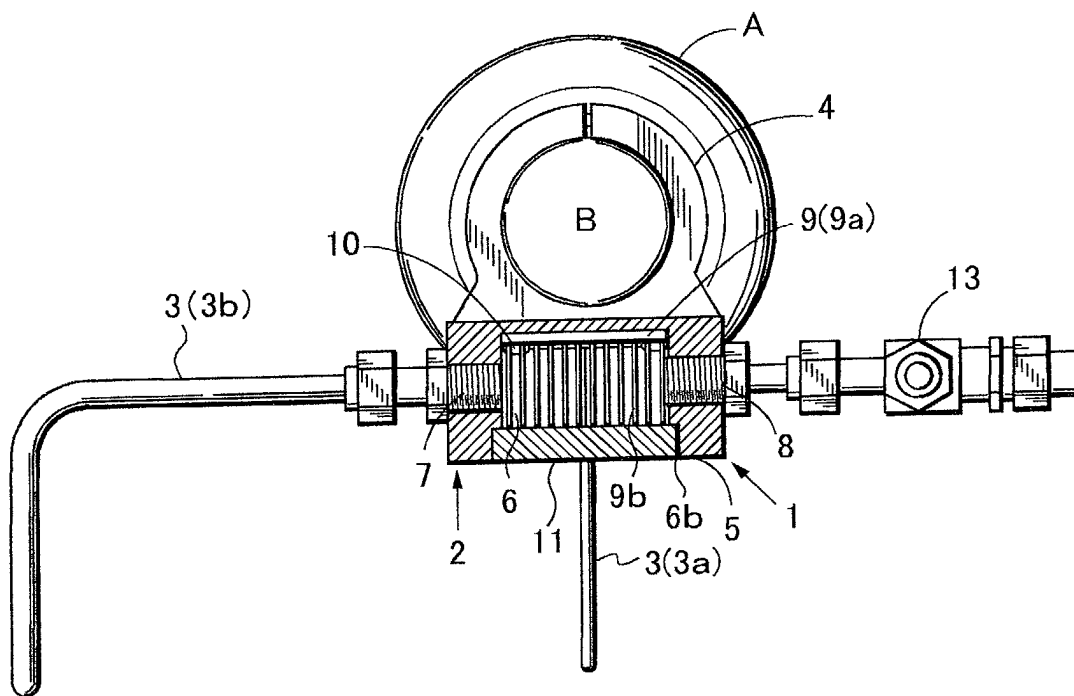


FIG. 2

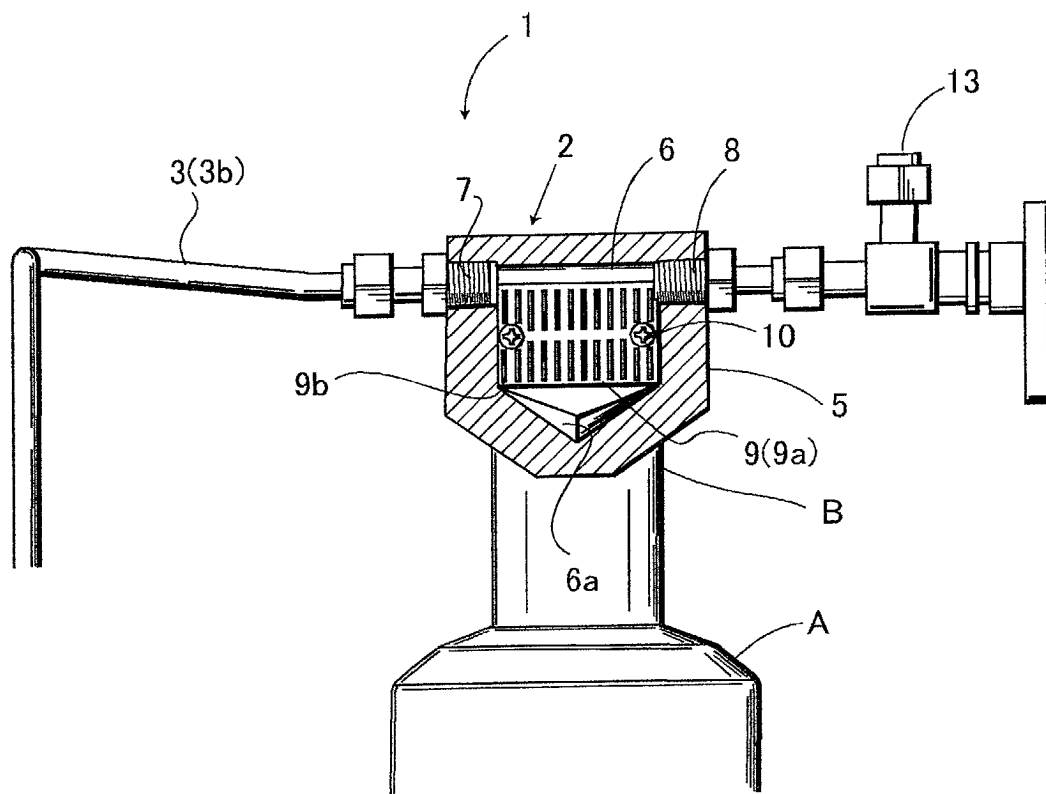


FIG. 3

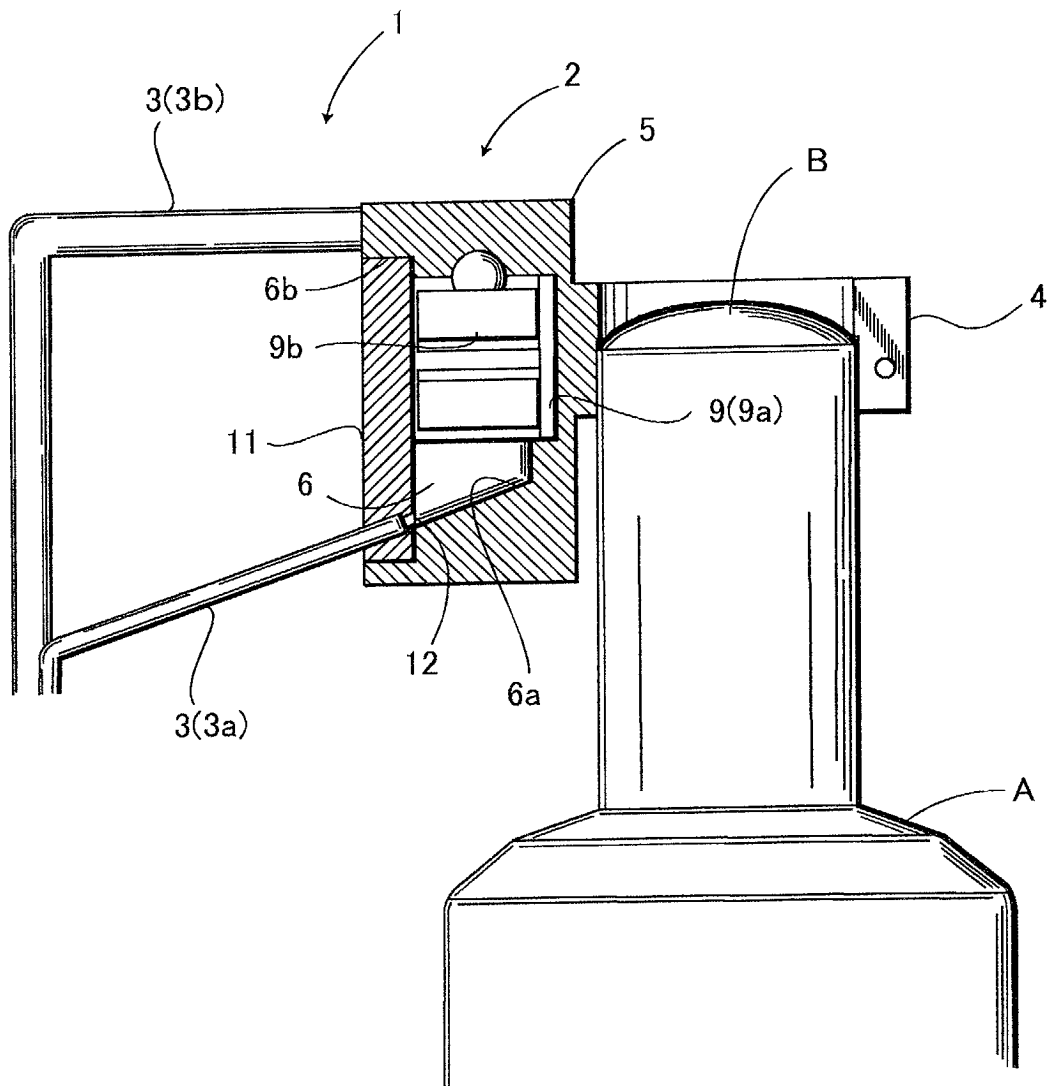


FIG. 4

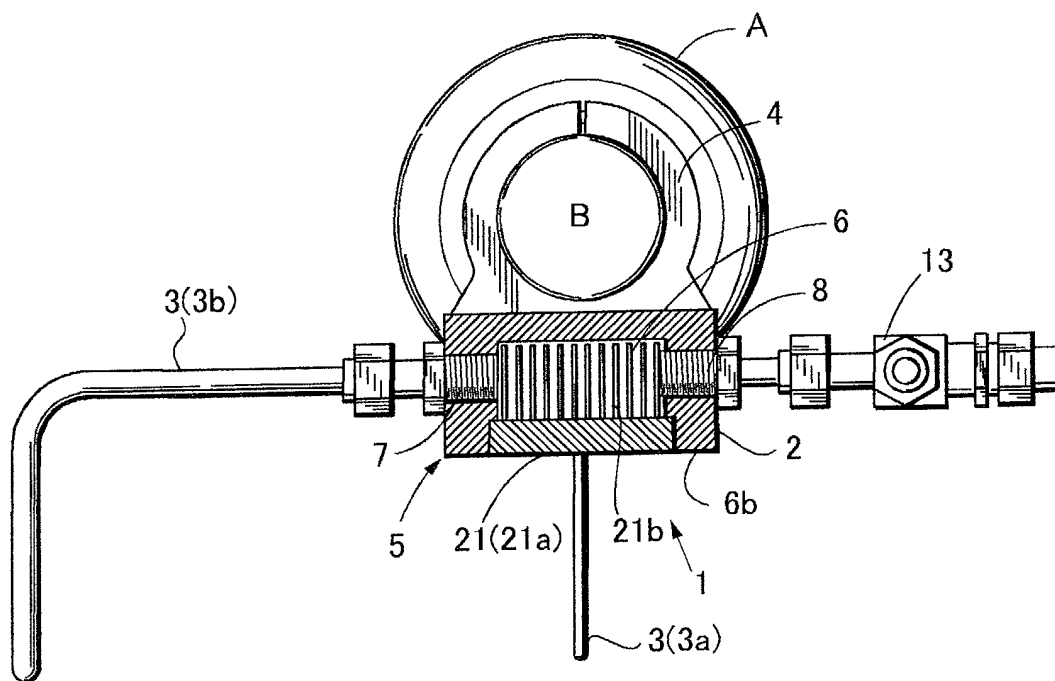


FIG. 5

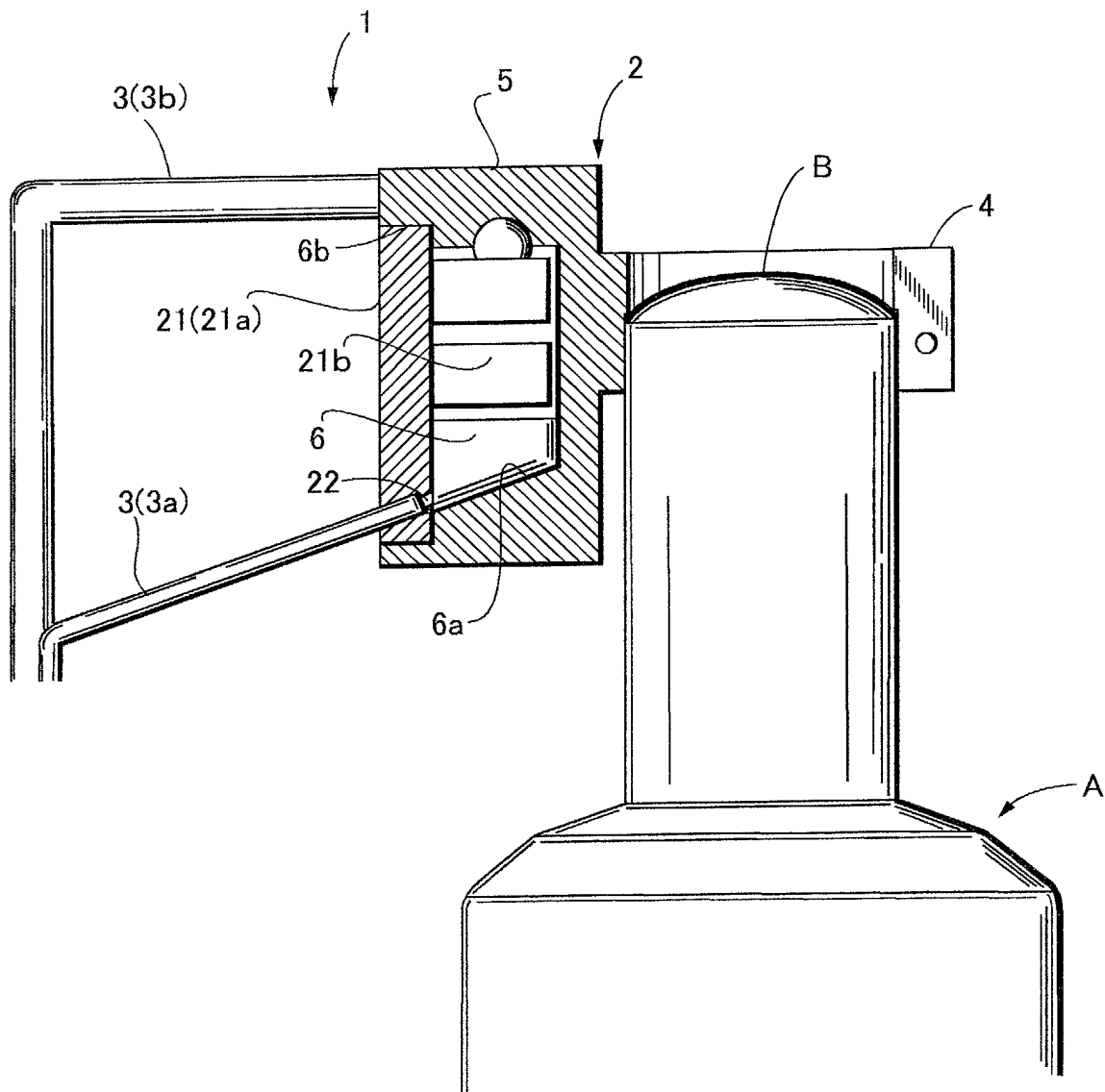


FIG. 6

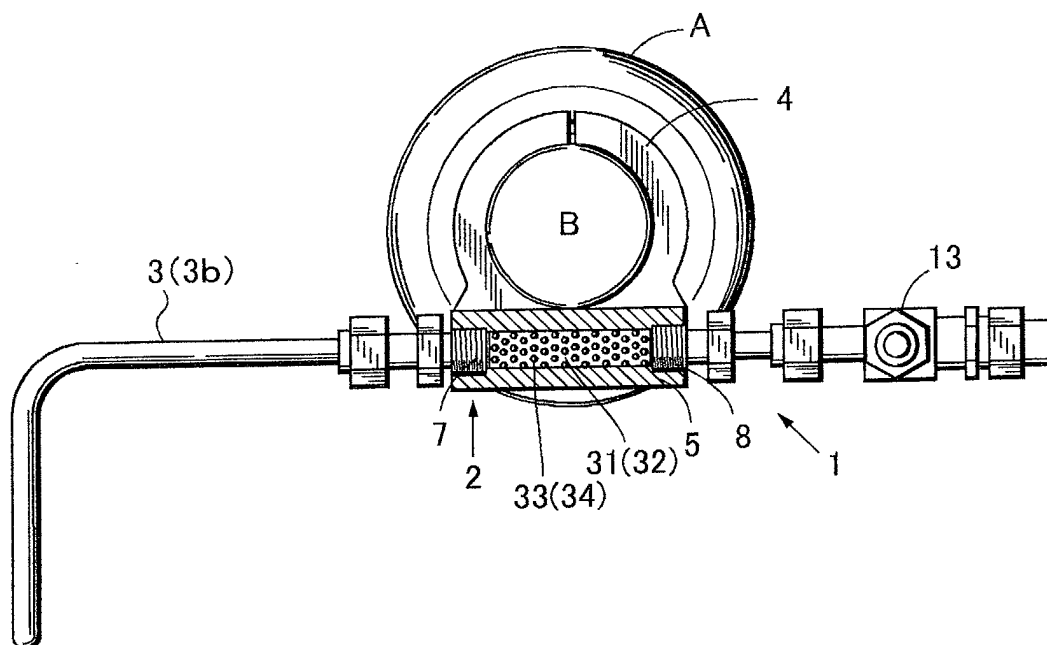


FIG. 7

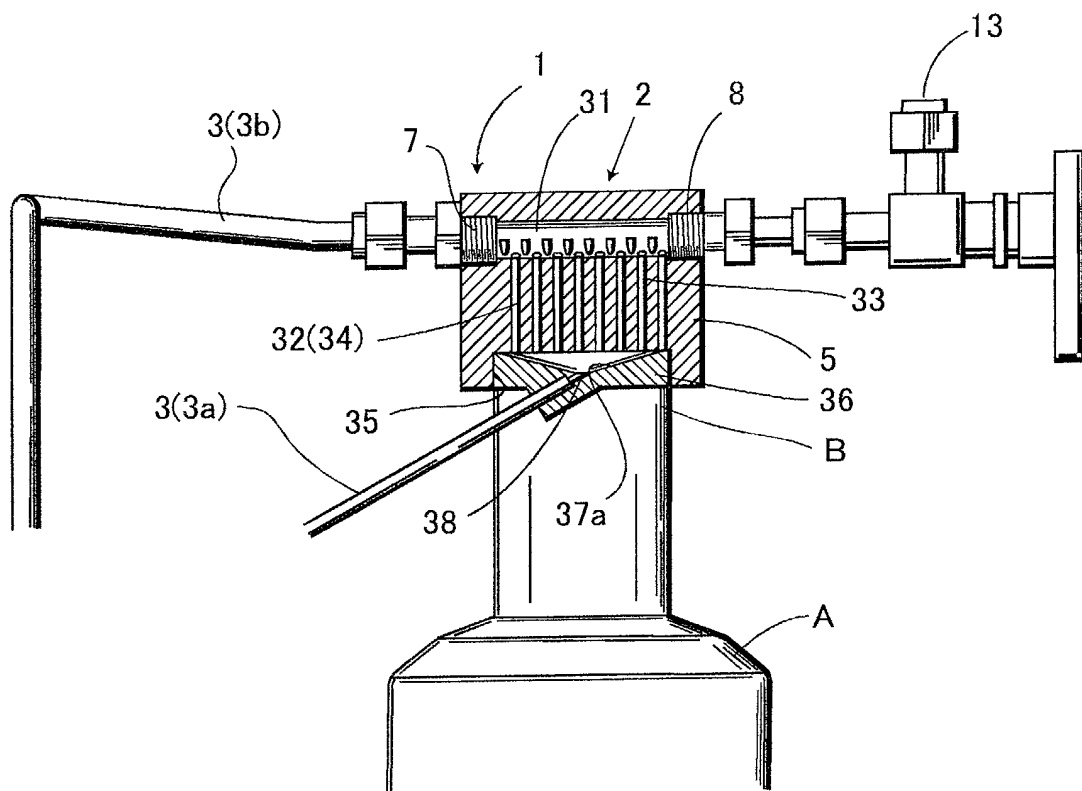
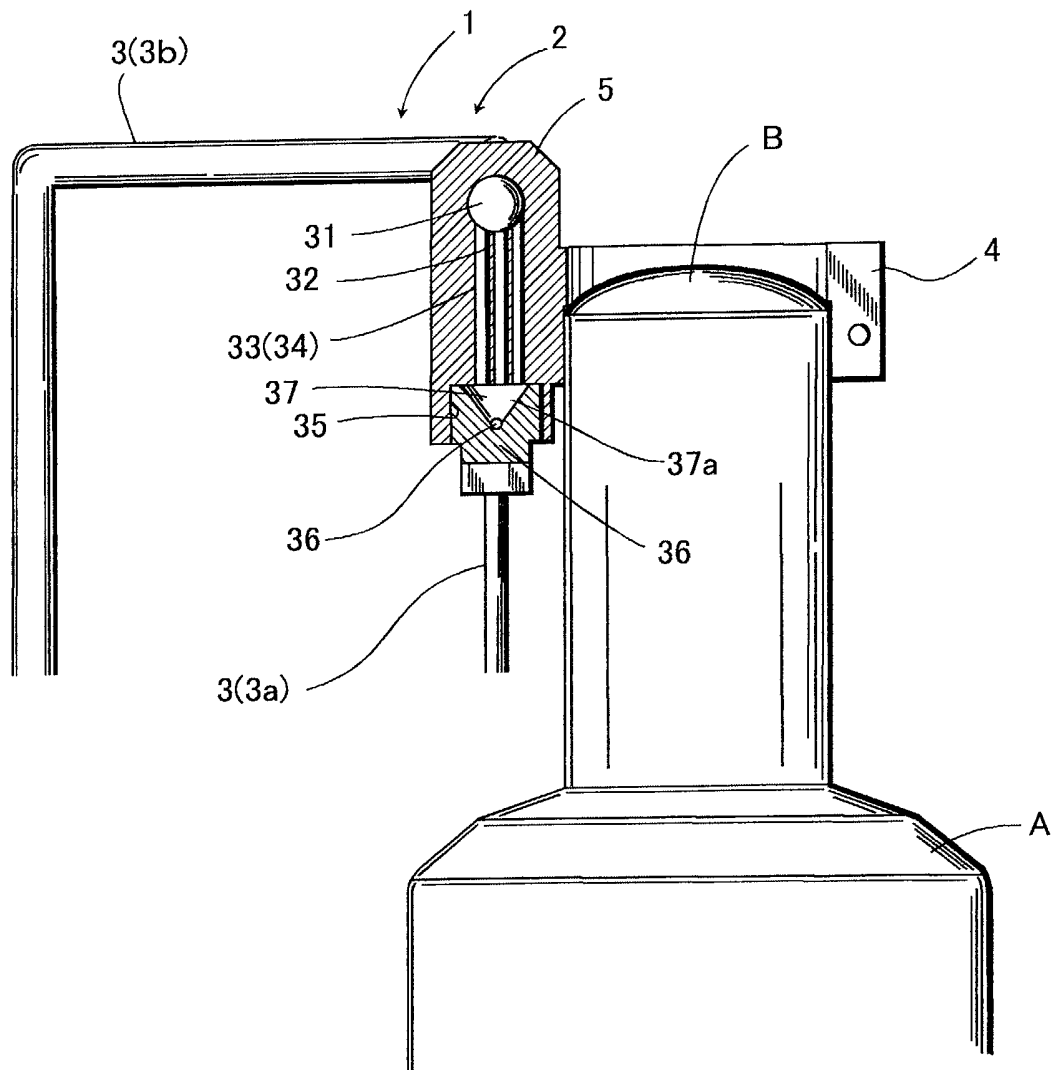


FIG. 8





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 01 40 2783

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 1 167 900 A (TSUIN BADO KOGYO KK) 2 January 2002 (2002-01-02)	1,4	F28D15/02
Y	* column 3, line 31 - column 5, line 3; figures 1-3 *	2,3	
Y	US 5 142 872 A (TIPTON RUSSELL C) 1 September 1992 (1992-09-01) * column 7, line 35 - line 62; figures 2,7 * * column 8, line 45 - line 49; figure 10 *	2,3	
A	GB 2 313 182 A (TOKYO SHIBAURA ELECTRIC CO) 19 November 1997 (1997-11-19) * page 12, line 3 - page 13, line 19; figure 1 *	1	
A	US 2 405 392 A (ATCHISON LEONARD W) 6 August 1946 (1946-08-06) * column 2, line 29 - column 3, line 49; figures 1,2 *	1	
A	DE 134 118 C (LOUIS CHARLES REESE) 2 October 1902 (1902-10-02) * page 2, left-hand column, line 21 - line 22; figure *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7) F28D
A	US 6 112 526 A (CHASE DAVID) 5 September 2000 (2000-09-05) * column 3, line 29 - line 39; figure 2 *	1	
A	DE 43 12 830 A (PRIVATES INST FUER LUFT UND KA) 27 October 1994 (1994-10-27) * column 1, line 63 - column 2, line 25; figure *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18 June 2002	Examiner Van Dooren, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 40 2783

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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18-06-2002

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 1167900	A	02-01-2002	JP 2002013885 A	18-01-2002
			EP 1167900 A1	02-01-2002
			US 2002023456 A1	28-02-2002
US 5142872	A	01-09-1992	EP 0454491 A2	30-10-1991
GB 2313182	A	19-11-1997	JP 10089867 A	10-04-1998
			US 6173761 B1	16-01-2001
US 2405392	A	06-08-1946	NONE	
DE 134118	C		NONE	
US 6112526	A	05-09-2000	EP 1147349 A1	24-10-2001
			WO 0037863 A1	29-06-2000
			US 6311498 B1	06-11-2001
DE 4312830	A	27-10-1994	DE 4312830 A1	27-10-1994

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82